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Observations

on

"The connection, and reciprocal influence of between the vital functions and mechanical force."

For the degree

of

Doctor of Medicine.

in the

University of Pennsylvania.

By

Robt. R. Reed.

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It were an easy task to trace the improvement of the rational powers from the time when Man

"— a sad barbarian, roving, mixed,
With beasts of prey; or for his acorn meal
Fought the fierce tusky boar; a shivering wretch."

to the period when

"— Society grew numerous, high, polite
And happy ——"

But the occasion does not demand it:— I shall therefore merely adduce one of the most splendid illustrations of this improvement which can be offered for our consideration, viz: Medicine.

This science may boast a greater antiquity than any other, — indeed in some one of its various departments, it has been almost coeval with the human race. As has been beautifully observed — "It cannot be supposed that uninterrupted health was ever among our happy privileges, and mankind always liable to accidents and diseases would naturally seek the measures of mitigation and

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relief." + But it was not till the revolution so much needed both in the intellectual & the material world ~~when~~ was unfolded — when Descartes, and after him, Malebranche & Locke, began with daring hands to tear aside the veil which had so long shrouded ~~the~~ intellectual philosophy — when the mighty efforts of Newton and Bacon gave a new face to the philosophy of the material world, that Medicine advanced in the proud march she has followed and which has lead to the high ~~elevation~~ rank she now holds. To Sydenham is due the credit of first applying to Medicine the inductive method of reasoning, which had been so happily employed in the other branches of science, and which so well entitles him to the distinguished appellation of "the restorer of Medicine."

Medical Science is not now confined to a mere observation of diseases, or to "the dry detail of pharmaceutical operations." Its sphere is more extensive, embracing in its range every department of Nature. The medical philosopher now makes as legitimate objects of his study the delightful discoveries of Botany and the splendid researches of Chemistry

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Anatomy and Physiology unfold all the wonders of organization; ~~and~~ Mineralogy reveals to him her hidden treasures and even the severe branches of science are made subservient to his purposes.

I would not revive the absurd doctrines of the visionary Asclepiades, and resolve all the operations of Life into Matter and Motion. Nor have I any ambition to restore to a place in Medical Philosophy the theories of the mechanical Physicians, who calculated the laws of the animal economy by the strict rules of Geometry, and represented the human system as made up of ropes and pullies and levers, combined with ducts and tubes, whose united operation they were wont to compute just as they would estimate the power of a pump or an engine!

My object in the following pages will be fulfilled by shewing "The connection and reciprocal influence between the vital functions and mechanical forces."

A knowledge of the principle upon which the vital functions depend for their operation, has ever been a desideratum with Physiologists; and the

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Anima Medica of Stahl, the Archeus of Van Helmont and the vis medicatrix of later times, has each in turn been reckoned the source of all vital action, and has successively furnished an explanation of the vital Phenomena of Life, satisfactory to the respective theorists and their followers. And now what remains of these systems, and a host of others that might be enumerated, save their memory? The human mind is too limited even to attain a knowledge of first causes. Here, as in the material world, we are checked in our attempts to learn the essences of things; — the result of certain modifications in each department forms the "ultima Thule" of our researches —

We must be content then with knowing what Life does and remain forever ignorant of what Life is.

The vital functions are certain operations carried on by systems, or parts of the same structure and cooperating in the performance of the same offices. In a general division, they may be reckoned as

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Voluntary, Involuntary and Mixed.

The first are those which are under the influence of the Will; the second are such as are removed beyond its influence and the last are partially controlled by Volition. Let a function of the last kind be made the subject of our inquiries, viz. Respiration.

∴ Respiration may properly be called a mixed function; for though indeed generally the motions of the chest are performed spontaneously, yet it will be hereafter shewn that an act of the Will can accelerate, retard or modify their motions.

This is one of the most important functions of the system; – indeed, on its proper performance the continuance of all the rest depends. It may be simply defined "the inspiration and expiration of air, following the dilatation and contraction of the chest."

Two kinds of Phenomena are to be observed in Respiration. One sort are entirely mechanical, as the motions of the Thorax, by which its cavity is expanded or diminished – the dilatation and contraction of the

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air vessels, and the ingress and egress of air which follow these motions. The latter kind are altogether chemical, such as the changes of the blood and inspired air &c. With the former kind alone we have to do at present.

In order to view the connection between this function and mechanical force, and the mutual influence exerted between them, it will be necessary briefly to describe some of the parts concerned in its performance.

The thorax, in which this function is carried on, is a conoidal, bony cavity, of a mean capacity between that of the head, and of the abdomen; and capable of dilatation and contraction in three directions, viz perpendicularly, transversely and antero posteriorly.

The principal motive powers in ordinary respiration are, the ribs, with their cartilages, — the diaphragm, and the intercostal muscles. The mechanism of the chest is admirably designed for the exercise of great power. This is especially true of the ribs which by their

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shape, position and insertion, display admirable contrivance for efficient operation.

But let us examine the muscular power and muscular force is nothing but mechanical force employed in the function of respiration.

In the antero-posterior dilatation and contraction of the thorax, the Diaphragm is mainly concerned. This principal muscle of is ascertained, can act in two directions, of its fibres, around three centres; and as need computed it possess an effect in dilating and contracting the chest, five times greater than all the other forces employed. From its primary importance in the execution of this function, it may readily be conceived how great the disturbance which would result from its injury or disability. This will be shown when we come to consider the function in its diseased action.

The intercostal muscles are the chief agents in altering the transverse diameter of the chest. These muscles are of two kinds external and internal.

they are attached to the ribs and operate by a kind of compound motion. Their tendency is, when they contract, to elevate the ribs; and they, from the obliquity of their position cannot be raised without having their middle portion carried outwards; and thus they alter the transverse diameter.

Each of these important operations is assisted by other subordinate agents, some of which will be mentioned in another paper. The antero-posterior direction is so little affected and the agency so inconsiderable as not to deserve notice here.

To apply what has been stated in illustration: Let us take an infant at birth. The function of Respiration, although every thing requisite for its operation is ready, has been as yet unemployed. The little stranger is exposed to the air, and what takes place? The air does not rush into the Lungs, as some Physiologists would say, to fill the vacuum. There is no vacuum. The lungs lie folded up, the interstices of the air cells are closed and the whole organ is

pressed upon by the sides of the chest, and by the diaphragm. As body is not and pass—, and consequently, produce motion, so that such things would continue unless the vital principle exerted its powers. The atmosphere, operating as a stimulant, calls into exercise this master principle, and the infant is decided to contract the Diaphragm and to elevate the Ribs. Then instant, a vacuum is produced, and the air, by its tendency to an equilibrium, is forced into the Lungs.

It may be told that an infant at birth, has no the exercise of its Will. To this, I would answer, that as the first increments of the velocity which carries forward the tremendous avalanche, are not perceptible, so the first movements of the mind of a Newton, are exceedingly feeble and indistinct.

Nothing is more certain than that many sensations are perceived, and many actions performed without consciousness, yet the mind is still employed.

The operation of expiration is easily understood.

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of muscular force is weakened by continuance; and its agents are fatigued by their own action. There is therefore a tendency now observed, to return to the original state, especially if there has been in operation a counteracting power. This is merely the case with the moving powers of the lungs; for whilst one set of muscles is employed in enlarging the diameter of the chest, another set is as intently engaged in attempting its contraction. This latter tendency have most of the muscles of the abdomen. Some of them are inserted into the Ribs, and endeavour to restore them, when elevated, to their proper places. To all these ones, must be added the elasticity of the Ribs themselves and their cartilages, which is by no means inconsiderable.

Most alarmed conceptions may be had of the astonishing force exerted by the muscles concerned in Respiration, when we consider the experiment, so often tried, of a person lying on his back and supporting on his breast the immense weight of a large anvil

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it which is added the act of swallowing. Hence, the vital principle, we believe is the preservation of the system over which she presides. Directs the strong inhalation in the chest; and in this function the external muscles (particularly the serrati) draw the ribs forcibly outward and sideways. The inspiration commences which saw sustain a weight with impunity that would inevitably crush the sternum and ribs of a dead body.

We have thus hastily considered the function of muscular force in healthy respiration: — we shall now view the subject in regard to its function in disease.

Let us take the case of a wound of the Diaphragm. What a disturbance of the function now occurs! The vital principle soon recovers from her panic, and directs the total quiescence of the injured muscle, quickening into more active exercise the ordinary agents of respiration and pressing into her service those hitherto unemployed. The scalenus and

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cervicular muscles, with others that might be enumerated are modified in their action, - their ribs become movable points and by their united operations they are enabled to fulfil the functions of the disabled organs.

Again - let a rib be fractured or let the pleura costalis be inflamed; and what do we witness?

The intercostals cease their operation. - the Diaphragm redoubles its exertions, calling to its assistance all the auxiliary muscles of the abdomen; and thus subserves the purposes of respiration, without the cooperation of the intercostals.

These respective phenomena might be examined as they are to be observed in Ascites in Pregnancy and in Consumption; and we might consider the mechanical force exerted in the various modifications of the function, in coughing, sneezing, yawning &c. - but my limits will not permit. I shall hasten to consider the subject in relation to the Lungs themselves

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